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Solutions for information sharing within turnaround maintenance

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Executive Summary

Solid Valu**e** of Digitalization in For**e**st In**d**ustry – SEED is an ecosystemic project that aims to develop competitiveness of Finnish forest industry by applying digitalization in a smart way. Besides forest industry SEED involves IT, service design and engineering companies and service and solution providers and research organizations.

In SEED one of the research questions is "how digitalization could support planning and execution of turnaround maintenance?" This activity is a periodic maintenance operation in which plant is shut down to allow for inspections, repairs, replacements and overhauls that can be carried out only when the assets are taken out of service. Turnaround projects are huge in terms of manpower and financial expenditure, and they have a direct connection to company's profitability. Especially preparation and planning of a turnaround poses challenges for asset management managers, because there are many things that should be taken into account, including prioritizing the maintenance tasks, purchasing spare parts, ordering contractors and scheduling the maintenance activities.

In the industry, asset management managers often lack a platform where they could check the status of the planning phase at a glance. Information regarding the planning process is scattered in various systems, and it is time consuming and complicated to make sure that everything is ordered and everyone is correctly prepared for the turnaround. Another major source of challenges is the involvement of multiple internal and external stakeholders during the turnaround execution. Huge amount of information is generated during the shutdown, and it is challenging to share the information to people who need it. Therefore an information sharing system is needed to help turnaround managers to manage the project in real-time.

In this report, we review software products that could offer solutions for the challenges in turnaround project planning and execution. As a result, a list of commercial project management software solutions and their focus areas is presented. Majority of the commercial turnaround maintenance software rely on features of project management methodologies and provide the basic functionalities for planning, schedule management, cost management and reporting. In addition, we present a review of the solutions that could provide situational awareness in a work place with a variety of companies and organisations. Construction and container terminals were chosen as benchmark branches.

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1. Introduction

Turnaround maintenance is a periodic maintenance operation, in which a production unit is shut down to allow the execution of such inspections, repairs, replacements and overhauls that can be carried out only when the assets are taken out of service. Turnaround maintenance is often called shutdown or outage maintenance. A major source of complication in turnaround maintenances is the involvement of multiple internal and external stakeholders (Al-Turki et al., 2018). Managing various simultaneously executed tasks and communicating the progress to stakeholders require extensive skills and tools.

Turnaround maintenance management managers face similar challenges in various industries, including steel, forest, chemical and energy industries. In general, the challenges cover issues including (Rantala et al., 2021):

- coherent management of the task and the availability of information (e.g., task list and prioritization) to relevant people
- sharing information between the different stakeholders at the planning and execution phase
- prioritization, selection and planning of the tasks in turnaround maintenance
- follow-up of the progress in the light of key performance indicators (costs, work force and other resources, schedules, task planning, safety, situational awareness for tasks etc.)

The performance of the turnaround planning phase is crucial for the success of the turnaround maintenance execution phase. Also, the efficiency at the execution phase requires skilled management, refinement and sharing of data, refined information as well as the processes, tools and situational awareness that help to manage activities and to response deviations in due time. In an ideal situation both planning, and execution phases could make use of data that is available for all relevant stakeholders. However, currently the necessary data resides often in IT-silos and is not readily available online.

1.1. Objective of this report

In this report, we present and analyse a variety of commercial software product that support turnaround maintenance planning and execution. More specifically, we focus on the software features that support the exchange and use of data in the planning phase and in operational turnaround maintenance work. In addition, we bring forth solutions that could provide situational awareness during the execution and experiences from other industries regarding on the tools that support information exchange in a multi-actor working environment. Construction and container terminals were chosen as benchmark branches.

2. Benchmarks from port terminal operations and construction business

2.1. Container terminal environments

A container terminal is an environment where several internal and external resources work together. There is a need to effectively predict and manage the performance of operations as well as the logistics of several companies. Terminal Operating System (TOS) is a major IT system that is used to manage the terminal environment as a part of a supply chain. The primary aim of a TOS software is to control the movement and storage of cargo by planning and observing the operations at the terminal. TOS is also used for better managing the assets and labour, to plan the workload and to share up-to-date information.

The TOS system is primarily used to manage cargo, machinery and people, but it is also a centralized design, management and optimization software. TOS allows managers to monitor the activities at the port. TOS

works in real time and thus provides an opportunity to manage and optimize the performance based on real-time data. Some TOS providers provide features for information sharing for 3rd parties (e.g., SmartAccess by Navis, https://www.navis.com/en/products/smart-apps/). The features are referred to as "open" or "integrated" TOS.

TOS software solutions are dedicated to the management of logistics operations efficiently and safely on a continuous basis whereas maintenance shutdowns are managed as projects. However, the two operating environments share common features including:

- a need to collect asset and people related online data in an environment with various organisations and people at site working in several different tasks,
- a need for real-time views on work and asset status to manage the complexity

TOS software solutions include functionalities that correlate with ERP functionalities. Functionalities that could offer interesting ideas and learnings also in the maintenance context include "*operational planning*", "*accessibility with mobile*" and the concept of "*a single integrated platform*".

2.2. Construction business

Construction is often regarded as one of the least digitalized industries. However, there is a variety of commercial management software that meets the specific needs of construction business. It is also stated that "*the discipline of project management enjoys different states of maturity across different industries*". The construction industry probably enjoys the greatest maturity in the field (www.interplansystems.com).

Majority of the software products on the market provide capabilities for project management and for sharing design and planning information between the stakeholders. Like in many other businesses, communication and information sharing is among the focal bottlenecks and the software offerings on the market aim to solve the related challenges.

Solution providers exist for situational awareness at construction sites. Examples include:

- ***FIRA Smart Services*** that provides a "*situation room for leading with data*" that specifically provides managers with tools to get an overview of recent progress of the work at site, predict performance and to react to disturbances on time. Further information available at: https://www.fira.fi/en/services/construction/situation-room/
- ***Pointscene*** provides a solution that integrated different worksite data to the tools and systems that users are already familiar with. Further information available at: https://pointscene.com/connect-and-control/

In addition to project management, solutions for advanced and effective information sharing are available. In the following chapters, two software solutions are presented as examples.

2.2.1. Connecteam

Connecteam software provides an information sharing and management environment for an organization that is mobilized, and the use of mobile devices is required. The software does not provide advanced work planning or project planning functionalities but focuses on the routines for sharing relevant up-to-date information between the key stakeholders and people. Thus, it does not compete with project planning tools but offers the necessary features of work chat, task assignment and task management, mobile field reporting, checklists and for processing and sharing the refined data. It therefore combines the work of deskless

employees and managers with real-time reporting, information sharing, updates and announcements. Figure 1 presents the elements of the software.

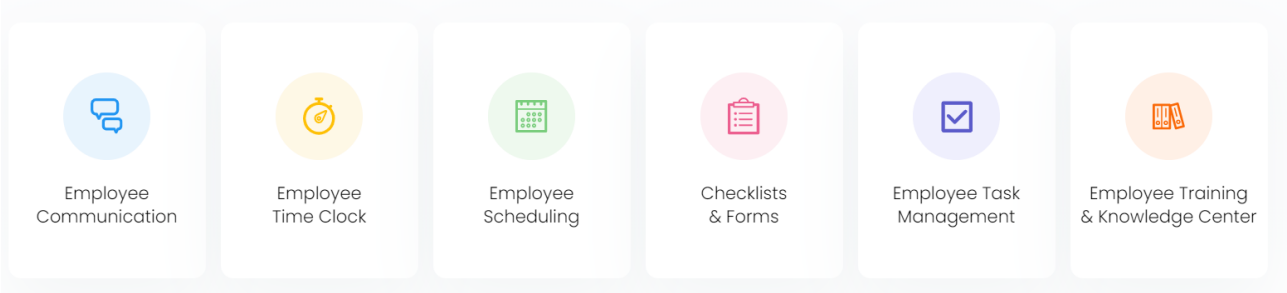

Figure 1. Elements included in the Connecteam software.

Further information can be found in: https://connecteam.com/ and https://connecteam.com/construction-app/.

2.2.2. Smartsheet

Smartsheet provides an advanced package for project planning and management, combined with a variety of features for e.g., reporting, work status information and safety issue management. Furthermore, the software can be integrated with other cloud and messaging applications. The mobile application enables access to data and a dynamic view so that one can tailor the dashboard views shown based on the specific requirements of the tasks of the person.

Smartsheet software provides situational overviews and task specific reports through the features of "*Control Center*" and "*Dynamic view*". Figure 2 present examples on the situational overviews that can be provided at different levels by the software (strategic, management, task and people performance etc.).

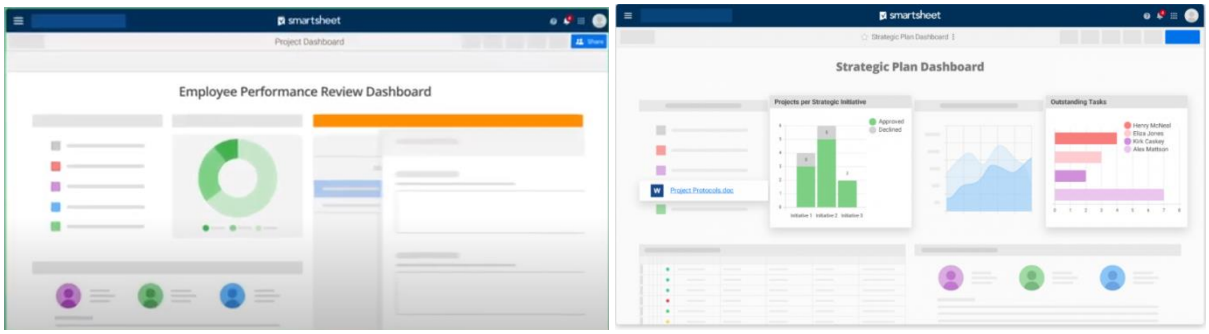

Figure 2. Examples on the situational overviews in Smartsheet software.

Further information can be found in: https://www.smartsheet.com/ .

3. Turnaround maintenance management software

In recent decades, turnaround planning has evolved towards a project-like approach and at the same time general project management tools (e.g., MS Project) have been introduced (Rantala et al., 2021). In addition to the project management tools, commercial software solutions that take into consideration the specific requirements of turnaround maintenance management are on the market. The software packages emphasise following features (example from InterPlan Systems, www.interplansystems.com):

- The dynamic nature of the scope of the turnaround (partly based on a rather loose scope at the first stage as well as the fact that all information is not available until inspections are made). Scope is thus based on past turnaround experience, results of the inspections, and operations requests.
- the scope is provided with more details by time and the scope is finalized near the actual shut-down
- the tasks carried out in turnaround are based on work orders
- schedule is subject to change in short notice and thus measure time is in hours instead of days or weeks

Due to the dynamic scope and changes during a shutdown, "*it is critical for all schedule and progress information to be highly visible, timely, comprehensive and accurate*" (www.interplansystems.com). Integration capabilities are needed to collect and further analyse all the relevant data. Figure 3 and Figure 4 illustrate the integration of the different software.

The software packages highlight capabilities to provide "*all the information in one place*". The actual requirement in this context is that people have an easy access to all relevant information that is needed in the context of their work. This requirement translates into the need to integrate information systems and to build up user-specific and user-centric views on data collected from multiple sources.

Figure 3. Integrations between different systems. https://www.prometheusgroup.com/solutions/reporting-and-analytics

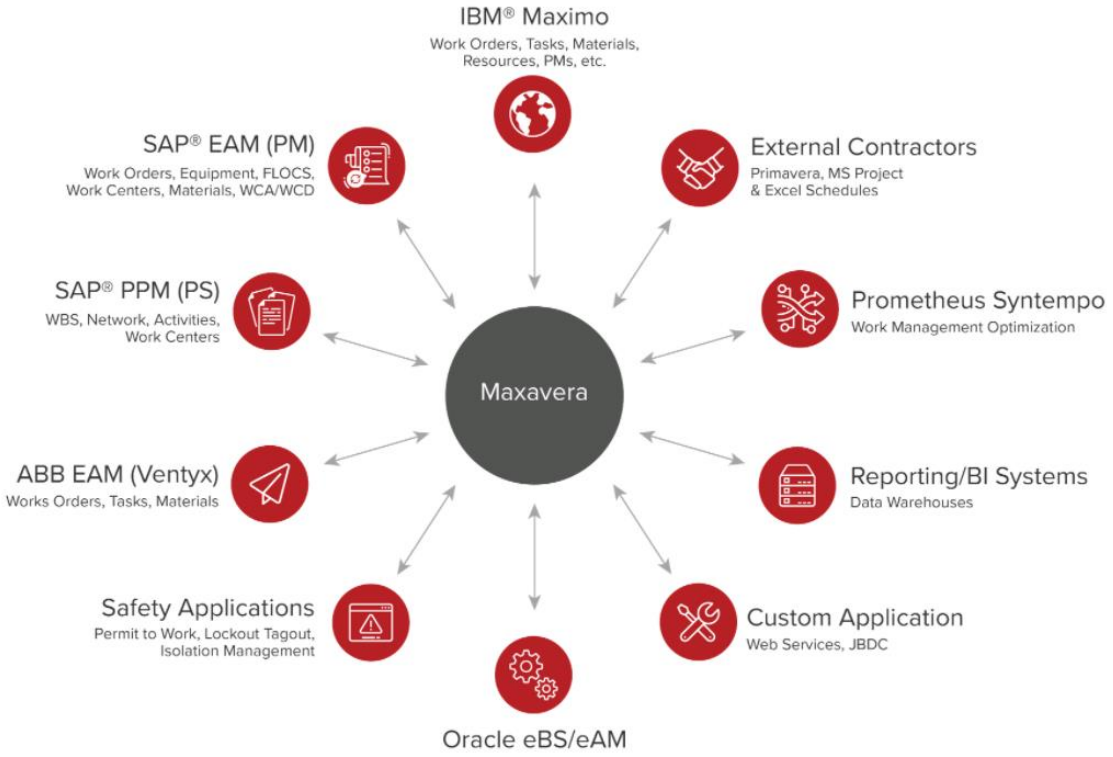

Figure 4. Integration with multiple systems by Maxavera (https://www.prometheusgroup.com/solutions/shutdown-turnaround-and-outage)

The following sections describe on a very coarse level a collection of commercial turnaround planning software that is available on the market. In our study, Prometheus is among the most comprehensive software on the market, and it is presented thoroughly in the following section (Section 3.1). Section 3.2 provides a comparison of the selected commercial solutions.

Prometheus platform offers a Shutdown, Turnaround and Outage Management solution (**Figure 5**), that consists of various tools including:

1) **STO Planner** – Web-based command centre to optimize tasks from planning to execution.

- Web-based solution that can integrate into all other systems
- Streamlines communication, reporting and documentation
- A robust scope management system
- Planning progress tracking – teams can measure if they're on schedule
- Real-time and dynamic updates
- Scheduling and reacting to changes in real time
- Provides real-time status updates and tracking of material requests and approvals
- Role-based access - different roles have access only to the appropriate data
- Assessing and analysing the work requests for your upcoming plant shutdown.

2) **Maxavera** - Integration software solution that communicates and connects multiple systems together

- Integrates ERP, EAM, EHS and CMMS
- Transfers all necessary information such as work orders, task lists, equipment details and permits between systems so that all workers are working with the same data

3) **Syntempo** – integrates and extends existing systems to create a single, unified command-and-control centre for managing the facility or turnaround maintenance.

- Integrates all work order, schedule, clearance and RP data into a single unified view
- Real-time visibility into maintenance and ops work control areas and view jobs that are delayed or are ready-for-work
- Multi-system data integration (including SAP, Maximo, Primavera)
- Dashboards and reports
- Collects progress updates directly from the field
- Real-time schedule monitoring to all parties involved in the project
- Allows contractors to update and provide progress reports on work status

4) **Workforce Management** – eases the management of internal and external workers

- Contractor cost tracking
- Captures and reports detailed labour data in real time
- Gives teams full control over their labour costs while automating the most complex work rule

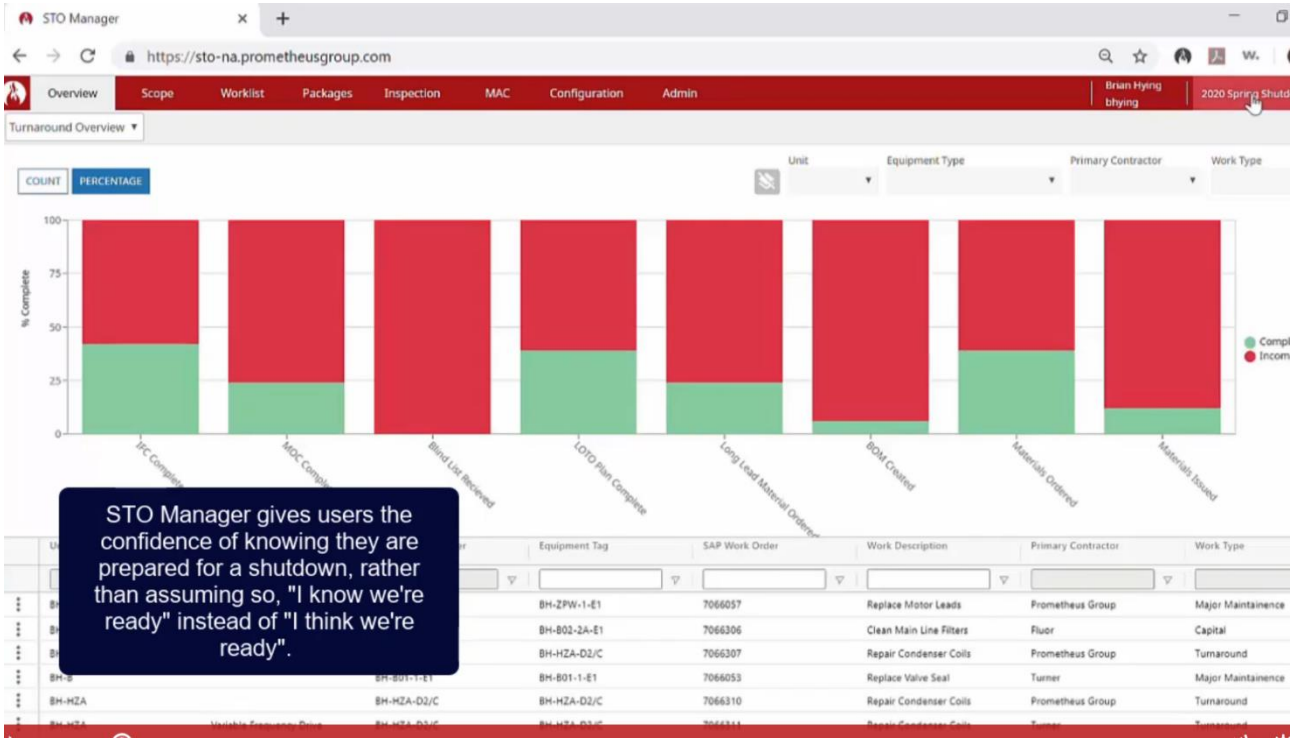

Figure 5. Screenshot of STO Manager

STO Manager provides comprehensive overview of the turnaround maintenance planning process. Turnaround maintenance planners can use the tool to plan, track and organize their projects.

3.1. Comparing focus areas and software solutions

Table 1 presents a selection of software solutions for turnaround maintenance planning and management, with a comparison of their focus areas. The selection of the software products and the features is based on an Internet search.

Table 1. Focus areas of selected commercial software products.

Trade name	Focus areas	Other features and remarks
iPlanSTO https://www.iamtech.com/products/shutdown-turnaround-outage-software	• *Focused on project management* and creation of the workflows for different processes for turnaround • Involves all people at different stages of the shutdown and use of history information of previous shutdowns for the planning phase • This software is among the lightest packages available on the market, with the emphasis on only a few process parts.	• Mobile application can be used to monitor the ongoing tasks, reporting and planning • Features for time management • Integration to Microsoft Project, SAP, Maximo, IFS, Dynamics, Oracle, 4PS • Management designed to run on a tablet, PC, and to interact with on large touch screens in project management offices and conference rooms.
InterPlan Systems STO Planning and Management Software interplansystems.com	• *Planning focused* package with a very holistic collection of the most typical project management approaches, methods and tools	• The software package is divided into project planning focused and management focused sections (eTaskManager and ATC Professional) • Standard report formats for providing stakeholders with necessary information on status and changes are recommended
Impact Software Solutions http://www.impact-software.co.uk/	• Impact software package emphasizes the *project management features* with planning, monitoring and analysis features for the whole lifecycle of the turnaround project • The strength of the software seems to be in the continuous improvement of the turnaround operations, based on the analyses, best practices, KPIs and reporting provided by the tool	• Information exchange in the turnaround maintenance execution phase is not emphasized in the solution • No mobile interface
MPower http://www.monitor-mpower.com/software/mpower/shutdown-and-turnaround/	• Tools for managing costs and schedule of turnarounds • The software is characterised as an enabler for "*intensive data loading, complex rate tables, shift-by-shift data visibility, integration with existing systems and track change*"	• Web-based view for managers • No mobile interface • The relevance and importance of online data, work status and constant information exchange is less emphasized than in the more comprehensive STO management solutions
Prometheus Shutdown, Turnaround, & Outage Management Software https://www.prometheusgroup.com/solutions/shutdown-turnaround-and-outage **Roser Consys** is currently part of Prometheus. https://www.roserconsys.com/en/home.	• According to reviews available, Prometheus software is *among the most extensive software offerings* for turnaround maintenance management • Prometheus provides a platform that Roser Consys is currently a part of	• More features about Prometheus is discussed in previous chapter • Roser Consys is designed for the whole lifecycle of turnaround, view-it functionality for user specific information visualization. • Mobile app is provided, with an interface to digitally monitor the progress of the work and to manage it • Together with the other offerings from Prometheus, Roser Consys can be seen as a benchmark for the industry
Cleopatra Enterprise Total Turnaround Management https://www.stocontrol.com/	• Cleopatra STO Control offers a comprehensive software package for the whole lifecycle of a turnaround • The software aims to "*combine scope management, work planning, estimating/budgeting, contract management, tendering, scheduling, field change management, cost control, benchmarking and TAR knowledge base*" • The software is project management and cost management driven	• Status and KPI monitoring capabilities with adaptive dashboards • Field change management with mobile app • Additional communication features or modules are not included.
Primavera https://www.oracle.com/industries/construction-engineering/primavera-p6/	• The scope of Primavera is in scheduling and resource management in large-scale programs and individual projects	• Primavera is not STO specific but a generic tool for project management • No mobile interface
STOlogix https://www.stologix.com/stoplanner/	• STOLogix is designed for scoping and planning process optimization and materials management.	• Tailored dashboards for different roles • No mobile interface • Interfaces needed for CMMS, financial systems, materials management, and equipment data sources.
Ultimo https://www.ultimo.com/module/stop-planning,	• 'Stop planning' is part of the asset management offering (a module) by Ultimo. The software is planning and change management oriented.	

4. Summary

Solutions for improving and streamlining the communication, sharing relevant information for all employees and stakeholders, promoting chat for specific groups, sending announcements and reporting are commonly applied in some industries. For instance, construction business is very human resource intensive and the role of automation and machines in the work processes is limited. This calls for capabilities to manage people and to coordinate a variety of simultaneous tasks. In this environment, the need for communicating both the formal task management information but also many daily practicalities is evident. The construction industry has made use of both structured software solutions and various free-of-charge applications (such as Whatsapp) for informal communication.

Majority of the turnaround maintenance software on the market rely on features of project management methodologies and provide the basic functionalities for planning, schedule management, cost management and reporting. In order words, they primarily provide support for management. In addition, the most comprehensive software solutions provide more advanced solutions for communication, they are modular, and they can be customized (the visualization and exchange of data and information in particular). **Figure 6** presents the modular structure of Roser Consys as an example.

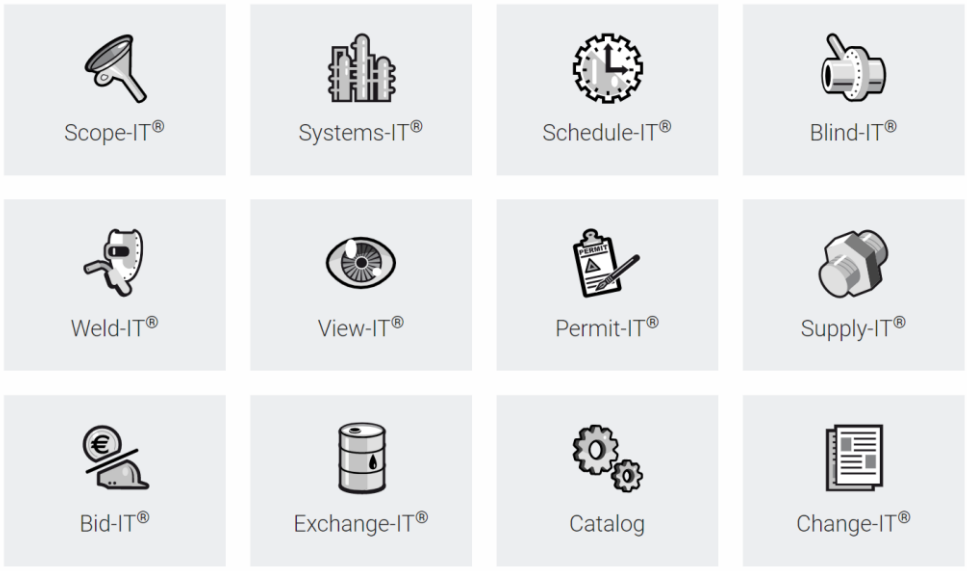

Figure 6. Modules in Roser Consys.

It seems that vendors with large offerings (e.g., Prometheus) have specifically emphasized the modularity and integration capabilities while they provide holistic asset management solutions where STO management is a part of. To better analyse the functionalities and features of the software presented in this report, a thorough analysis is needed where requirements are better specified, and demonstrations of the software are used.

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Cleopatra web site: https://www.stocontrol.com/

FIRA web site: https://www.fira.fi/en/services/construction/situation-room/

Interplan Systems web site: www.interplansystems.com

Impact web site: http://www.impact-software.co.uk/

Interplan web site: http://interplansystems.com

IPlanSTO web site: https://www.iamtech.com/products/shutdown-turnaround-outage-software

MPower web site: http://www.monitor-mpower.com/software/mpower/shutdown-and-turnaround/

Navis web site: https://www.navis.com

Pointscene web site: https://pointscene.com/connect-and-control/

Primavera web site: https://www.oracle.com/industries/construction-engineering/primavera-p6/

Prometheus web site: https://www.prometheusgroup.com/solutions/shutdown-turnaround-and-outage

Roser Consys web site: https://www.roserconsys.com/en/home

Smartsheet web site: https://www.smartsheet.com/

STOlogix web site: https://www.stologix.com/stoplanner/,

Ultimo web site: https://www.ultimo.com/module/stop-planning